Packer's Workload Assessment, Using the OWAS Method

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One of the elements of the logistics system is the subsystem of production, which is a combination of physical elements such as machinery and equipment, tools, and (most importantly) people. Furthermore, systems dependent on the human-operator are particularly susceptible to problems from discomfort, leading to reduced production quality and an increase in the cost of training and absence from work. The aim of this study was to assess the workload and risk of musculoskeletal discomfort (MSDs) in the position of a logistics-packer, through an analysis of risk factors. A computerized version of the OWAS (Ovako Working Posture Analysis System) method was used to conduct the evaluation, in which 10 steps of the product packaging process were assessed. As a result of the assessment for the category of action categories (AC), six steps qualified as AC 1, 2 steps as AC 2, and 2 steps as AC 3. The main factors affecting the risk of a negative assessment of posture were keeping the back bent and twisted and keeping the legs bent at the knees. Work on the assessed position for two activities is associated with a significant risk of MSDs, therefore corrective actions should be carried out as soon as possible. Ergonomic intervention should be linked to: revision of the position and methods of work. After making changes to the assessed position, re-evaluation with the OWAS method is recommended to verify the effectiveness of the changes.
Keywords: OWAS, workload, ergonomics, risk, MSDs.

1. INTRODUCTION

One of the elements of the logistics system is the subsystem of production [Słowiński 2008, pp. 32] and the basic elements (resources) of each work process are people, means of working and items of work (products) [Słowiński 2008, pp. 88]. Production systems are defined as a complex system of physical elements such as machinery and equipment, tools, and (most importantly) people. Employees in a manufacturing system are "internal consumers" and the system must be designed to meet their needs. At the same time, production systems must produce goods that meet the needs of "external consumers". In terms of health and safety, the production system is designed to meet the needs of both internal and external consumers [Black 2007]. In addition, production systems dependent on human-operators are particularly susceptible to problems from discomfort, leading to reduced production quality and increased cost of training and absence from work [Kasvi et al. 2000].

Work performed by a person is accompanied by physical activity, which can lead to the appearance of musculoskeletal discomfort (MSDs) among workers [Vieira and Kumar 2004]. Studies have shown that employee posture at work, range of motion, strength required, repetition and duration must be taken into account when categorizing the level of physical activity [Kumar 1994]. The posture and movement of the operator during operation are important variables that must be taken into account in work safety because they are the two most important factors that determine the workload of the employee. The posture of an employee at work is affected by factors such as the job done, nature of work, work tools and the design of the position, along with the anthropometric characteristics of workers [Westgaard and Winkel, 1997, Vieira and Kumar 2004].

Research techniques proposed to estimate the level of discomfort and load postures associated with the adoption of different positions while working can be divided into observational techniques and observations based on devices. In the case of angular deviation, observation techniques for deviation of segments of the body from the neutral position is conducted by visual observation. However, for techniques based on instruments, continuous monitoring of posture is achieved through the use of devices connected to the worker. Due to the lack of interference in the labour process, low cost and ease of use, observational techniques are more commonly used in the industry [Genaidy et al. 1994].

Among the methods of observation used to assess postural load on employees are: OWAS [Karhu et al. 1977, Kivi and Mattila 1991], RULA [McAtamney and Corlett 1993] and REBA [Hignett and McAtamney 2000]. They have each been developed for different purposes, and therefore are used in different workplace conditions [Kilbom 1994]. Each technique has its own approach to the system of operator classification, which differs from the other techniques, and thus may result in differences in the final result of the load postures of the operator, depending on the technique used. One commonly used method is the OWAS method (Ovako Working Posture Analysis System). The publication of scientific studies have shown its usefulness in assessing worker posture at work in various environments such as warehouses [Grzybowska 2010], construction [Kivi and Mattila 1991, Li and Lee 1999], agriculture [Gangopadhyay et al. 2006], forestry [Calvo 2009], nursing [Engels et al. 1994, Hignett 1996], supermarkets [Carrasco et al. 1995, Ryan 1989] poultry industry [Scott and Lambe 1996], operation and maintenance of vessels [Jood et al. 1997], beverage distribution [Wright and Haslam 1999], the treatment of metals [Gonzalez et al. 2003], truck drivers [Massaccesi et al. 2003], processing of fish [Quansah 2005], cleaners in an office environment [Kumar 1994], in the steel industry, electronics, automotive and chemical industries [Sesek et al. 2004, Kee and Karwowski 2007, Muthukumar et al. 2012, Wang et al. 2012], etc. As well as design and simulation in areas such as design and modelling with the use of a digital human model [Lamkull et al. 2009, Minami et al. 2009], virtual modeling [Hirose et al. 2013], the design of workstations [Cimino et al. 2009, Hallbeck et al. 2010], the design of assembly systems [Battinii al. 2011], etc.

The aim of this study was to assess the workload and the risk of MSDs as a logistics-packer, analyzing risk factors using the OWAS method.

2. METHOD AND MATERIALS

2.1. OWAS METHOD

The OWAS method was developed by scientists with the participation of the Finnish company Ovako Oy [Karhu et al. 1977] and has been disseminated in many countries. The method was developed to assess the risk of exposure to MSD's associated with the posture of operators during operation. The complex approach is based on the technique of observing the employee on the job, taking into account the positions taken by the operator during operation by highlighting the following body segments: the trunk (back), arms, legs and external load in kilograms, which has a significant impact on risk. The basis for the assessment of exposure is the total degree of postural load and external load. The OWAS method is focused on the identification of problems and corrective actions which are expressed in terms of action categories (AC) evaluation. The main objective of the assessment therefore, is the possibility for disclosure and correction of unwanted body position during operation.

In this method, in the human model, three segments of the body are distinguished, which may take different positions and external load [Karhu et al. 1977, Engels et al. 1994, Scott and Lambe 1996, Sesek et al. 2004]. The OWAS method takes into account the load from four factors:

- back position (four items encoded: 1 – straight, 2 – bent forward, 3 – twisted, 4 – bent and twisted),
- position of the arms (three items: 1 – both below the shoulder joint, 2 – one above the shoulder joint, 3 – both above the shoulder joint),
- position of the legs (seven items: 1 – sitting position, 2 – standing with straight legs, 3 – standing with one leg extended, 4 – standing with legs bent, 5 – standing with one leg bent, 6 – kneeling on one or both knees, 7 – walking),
- external load in kg (three codes: 1 – less than 10kg, 2 – from 10kg to 20kg, 3 – over 20kg).

In total workload postures of the operator, the code consists of the code for position of back, arms, legs and the level of the external load, creating a four-digit code. Their combination creates categories describing the assessment of exposure to the risk of MSDs and the categories of AC required for the improvement of working conditions on the assessment position. The authors singled out the following action categories:

- AC 1 – normal posture without risk, with no particular adverse effects on the operator's musculoskeletal system; no intervention is required.
- AC 2 – there is low risk, the working posture has little detrimental effect on the musculoskeletal system; there is a light workload, but immediate intervention is not required. However, ergonomic adjustment should be taken into account in future actions.
- AC 3 – significant risk, working posture has considerable adverse effects on the musculoskeletal system; ergonomic intervention should be carried out as soon as possible.
- AC 4 – very high risk, working posture has a very large adverse effect on the musculoskeletal system; ergonomic intervention is required immediately.

A computerized method to evaluate employee postures was applied in the form of the WinOWAS computer program developed in 1996. The program was created by the Occupational Safety Engineering department of Tampere University of Technology in Finland.

2.2. ASSESSMENT SYSTEM

The subject of the assessment was the work of a logistics-packer operator located in the logistics-packaging hall in an automotive plant. The pattern of work was three-shifts, of 8 hours per day, 40 hours a week. The task of the employee was to pack specific items in a cardboard container. Cardboard boxes were located on a rack and it was necessary to deposit them in the appropriate place. The boxes were obtained from a shelf and folded into shape, then placed it in the workplace. The items for packing were located in metal containers. The operator was required to obtain the items from the metal container, conduct a visual quality control and place them in the box. Each box was packed with 15 units, closed and put on a wooden pallet located on the floor.

The operator performs recurring work consisting of ten steps (Table 1), as follows: "Obtaining items", "Visual control", "Placement ". The full cycle was repeated 15 times.

Table 1. Operations performed by the packer

No.	Activities	
	Name	Description
1.	Obtaining the box	Obtaining the box from the shelf
2.	Formation	Assembling the box
3.	Transport 1	Transfer of the cardboard box to the place of work
4.	Obtaining items	Obtaining item from the metal crate
5.	Visual control	Visual inspection of the item
6.	Placement	Placement of the item in the cardboard box
7.	Closure	Closure of the cardboard box
8.	Transport 2	Transport of the full box to the pallet
9.	Transfer	Transfer of the box to the pallet
10.	Approach	Approach to the shelf for new box

3. RESULTS AND DISCUSSION

The obtained results are presented in the form of screen prints from the WinOWAS computer program (fig. 1, fig. 2).

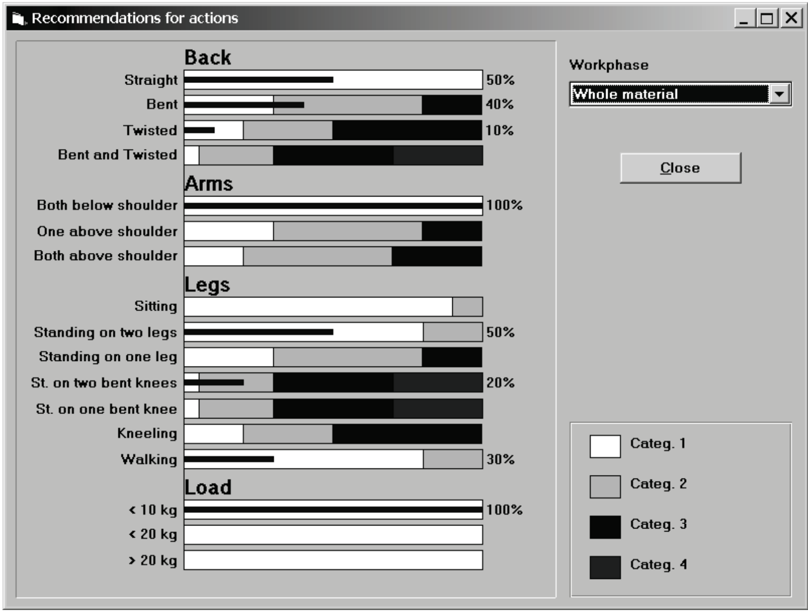

Fig. 1. Load rating of the body segments and external load

The evaluation of ten of the activities (Table 1) performed by the logistics-packer found that both bending and twisting of the back did not occur (fig. 1). The operator carrying out the task experienced the following back positions: (50% of all positions) – at the correct inclination (back straight), where there was no risk of MSDs; bent (40%), which resulted in the emergence of the risk of MSDs qualifying for AC 2. Back twisted also occurred (10%), however, it did not result in significant exposure to MSDs.

The operator constantly (100%) maintained both upper limbs below the shoulders, therefore the risk of MSDs in this respect did not occur, hence the rating AC 1 – no ergonomic intervention is required.

Legs were straight for part of the working time (50% of all positions), which did not result in any risk of MSDs. The packer also worked with the legs bent at the knees (20%), which resulted in the emergence of the risk of MSDs at AC 2 while performing the task of movement (30%), but the level of exposure to MSDs was negligible.

External load for 100% of time is at the level of up to 10kg. Risk associated with the load were small, AC 1, therefore no ergonomic intervention is required.

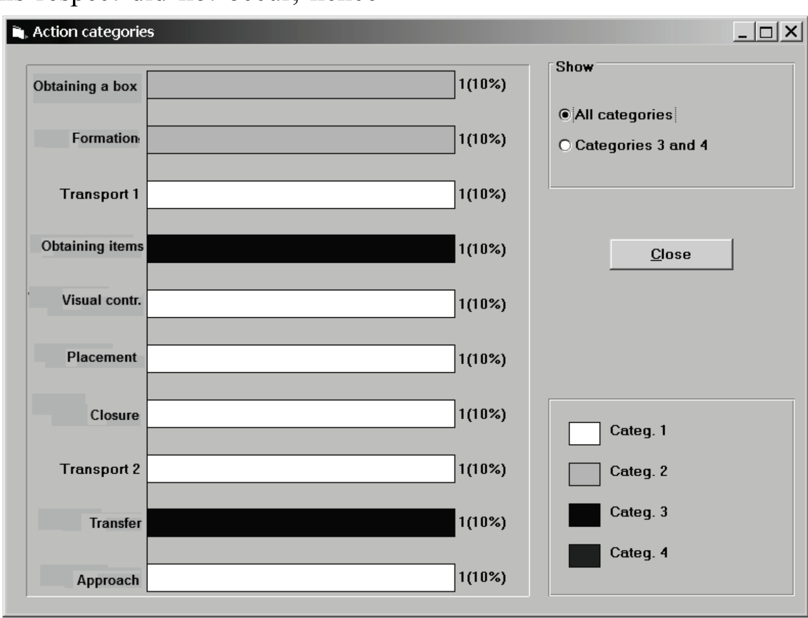

Fig. 2. Final rating action – action categories

Among all evaluated operations performed by the logistics-packer, six steps qualified for AC 1, two steps for AC 2 and two steps for AC 3 (fig. 2).

Ergonomic intervention in the case of "Obtaining items" and "Transfer" should take place as soon as possible, due to the high risk of MSDs.

The operation "Obtain item", associated with lifting down the item for visual control, was given a negative evaluation due to the position of the back. The item was placed in a metal container on the floor, which required the operator to reach for the item with bowed knees while bending and turning the back. Furthermore, the angle of inclination increased with the depletion of items in the container. However, in the case of "Transfer" actions, during which the employee placed the cardboard box packed with items on the pallet, the greatest risk occurred when laying the first layer of cardboard boxes. The pallet was placed directly on the floor, so that its top was about 20cm from the ground. A worker placing the cardboard box on the pallet was required to lean heavily forward and bow his knees.

4. SUMMARY AND CONCLUSIONS

An important element in production systems, in addition to the physical components, is the human factor which affects performance, cost and quality [Istota inżynierii produkcji 2012]. Improving logistics systems can cover not only the technical sphere but also the realm associated with the environment and ergonomics. Higher quality ergonomic work processes favour [Tytyk 2001]: better and more efficient work, biological reduction of labour costs, reduction in the number and cost of defects and errors in work, increase safety and eliminate diseases, better use of time, reduced sickness absence, increased job satisfaction and positive motivation.

The aim of this study was to assess the workload of a logistics-packer, with analysis of risk factors using the OWAS method. Rating the posture of the packer while performing the tasks showed that the following categories: AC 1 – 6 steps, AC 2 – 2 steps, AC 3 – 2 steps. There was no AC 4 rating assigned.

The main factors affecting the risk of a negative assessment of posture were keeping back bent and back twisted and keeping the legs bent at the knees.

Work on the research position for two activities is associated with a significant risk of MSDs, so corrective actions should be carried out as soon as possible. Ergonomic intervention should be related to the redesign of:

- the position of work;
- methods for the employee to conduct the task.

After making changes to the assessed position re-evaluation is recommended using the OWAS method to verify the effectiveness of the changes.

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